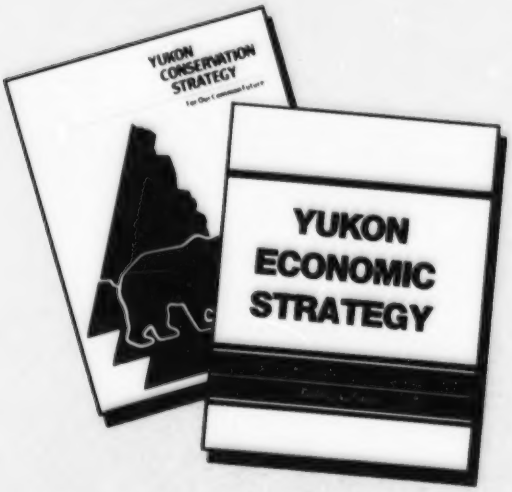
YUKON ENERGY STRATEGY

Energy Impact Considerations



Yukon
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YUKON ENERGY STRATEGY

ISSUE PAPER

ENERGY IMPACT CONSIDERATIONS

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Summary

This paper examines the concept of energy "externalities", reviews ways of including energy impacts in decision-making, and outlines options which can be pursued in the Yukon.

In the most general terms, externalities, or external costs and benefits, are "side-effects" which are associated with virtually any action. In more specific economic terms, a negative externality is any form of harm or damage which occurs during the production, distribution, use or disposal of a good or service that is not reflected in the costs borne by the producer or the price paid by the buyer.

The issue of externalities should be addressed as part of the overall strategy or framework for putting the idea of a sustainable Yukon energy future into action.

By including externalities into the planning process, Yukon people would have to address fundamental questions related to the implementation of a sustainable energy future. For example, what are all the impacts associated with all of the energy resource options? How should these impacts be valued? How should impacts be weighed? Who should be involved in the valuation process? Who will pay the costs of impact control or elimination? And how will these costs be shared?

Including externalities can help Yukon people make energy choices on the basis of least cost to society over the long term.

ENERGY IMPACT CONSIDERATIONS

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ENERGY IMPACT CONSIDERATIONS

1. OVERVIEW

1.1 Introduction and Purpose

This is one of seven issue papers prepared as part of the Yukon Energy Strategy Framework. The Framework and seven issue papers have been distributed to Yukon people to help stimulate informed public involvement in the development of a Yukon Energy Strategy.

Until recently, the costs upon which energy decisions have been based have included only the direct costs to consumers of energy production and supply. With a growing understanding of other kinds of costs, and with the strong commitment of Yukon people to an environmentally sustainable future and an equitable society, it is essential to broaden the terms upon which energy decisions are made. This issue paper will explore the concept of externalities and consider options which will take into account environmental, social and other economic impacts associated with energy production, distribution and use in the Yukon.

The specific goals of this paper are to:

- Introduce the concept of externalities.
- Review the kinds of externalities associated with energy in the Yukon.
- Examine how governments currently deal with externalities, and why a more comprehensive approach is desirable.
- Describe various approaches for ensuring that externalities are taken into account in decision-making.
- Outline options that can be pursued in the Yukon.

1.2 What Are Externalities?

In the most general terms, externalities, or external costs and benefits, are unintended "side-effects," and are associated with virtually any action. An example of a positive externality (external benefit), is the visual enjoyment neighbours take in the attractively landscaped front yard of the house next door. An example of a negative externality (external cost), is the decrease in adjacent property values that occurs when a property owner demolishes an attractive home and builds a parking garage.

In economic terms, a negative externality is any form of harm or damage that occurs during the production, distribution, use, or disposal of a good or service that is not reflected in the costs borne by the producer or the price paid by the buyer. In other words, externalities are impacts that result from economic activity, but are not reflected in basic market transactions. In many cases, these impacts lie outside market processes because they affect land, resources or values that are not privately owned, or cannot easily be reduced to private ownership, such as the atmosphere, the water, and fundamental ecological processes. Since "assets" that are not privately owned do not enter into market exchange, there is no incentive to consider the effects of development on them, unless society imposes an obligation to do so.

For example, if a producer wishes to establish a tannery, and requires access to a privately owned lake for his or her operations, he or she must buy the lake or pay the owner for its use, and this becomes a cost of production. If, however, the producer uses and pollutes water from a river that is not privately owned, the resulting ecological destruction, and the fact that people downriver can no longer fish or swim in the river, are of no economic relevance to the producer. Unless the government takes steps to force the producer to "internalize" the costs of these damages, the producer benefits by using a public good without paying for the associated damages.

2. ENERGY AND ENVIRONMENTAL EXTERNALITIES

2.1 Background: Energy Services and Energy Sources

When Yukon residents purchase a litre of gasoline or a kilowatt hour of electricity, they are buying a means of providing what we call an energy service such as space heating or lighting. This paper focuses on the environmental impacts - or externalities - associated with meeting energy service requirements.

As consumers, our main interest is in the services that energy provides. It is important to recognize, however, that many services can be fulfilled by more than one form of energy. Some energy services can be met by a primary energy form, that is one that does not need to be converted to be used, such as wood. However, most energy services are met through what we call secondary forms of energy. For example, electricity is a secondary form of energy that can be generated from such primary forms of energy as hydro, coal, or nuclear power.

In developing an energy strategy, we must choose between different sources of energy. It is important that options be compared for specific energy services. For example, while wood may be included as a fuel option for home heating, it cannot be considered as a viable alternative for transportation.

2.2 Framework for Understanding Environmental Impacts

Although this paper focuses on environmental externalities, it is important to recognize that many other types of externalities occur during energy development, supply and use. In fact, it can be difficult to distinguish among environmental, economic, and social externalities. For example, in native communities in other parts of the country, large scale flooding caused by hydro development has disrupted ecosystems which, in turn, has disrupted subsistence lifestyles. The final result was massive social problems. As many Yukon people will recall, the past debates concerning a Mackenzie Valley pipeline centred on the possible social and cultural impacts oil and gas development would have on native communities.

This paper focuses on environmental externalities because, until recently, the focus on environmental impacts associated with energy development was quite narrow. Since the MacKenzie Valley pipeline debates, the study of environmental impacts has dealt mainly with the disruption and loss of habitat. Today, things have changed. The study of environmental impacts due to energy development has broadened to include all land, water, and air impacts. Just as importantly, there is a growing recognition by governments, regulatory bodies, and industry that an understanding of these impacts must be part of the day-to-day decision-making process.

Environmental impacts occur at each stage of the life cycle of an energy source - from initial exploration through each stage of production (extraction, processing, conversion, etc.) to the transportation, storage, and marketing of the energy source to the use of energy (e.g., home heating, transportation, industrial drive power) and finally to the decommissioning of projects and waste disposal. The actual causes of environmental impacts may be referred to as residuals. This term refers to things put into, taken out of, or moved around or altered within the environment. The environmental impacts associated with residuals occur at points of vulnerability. For example, poor wood burning practices can result in high levels of particulate and other emissions. The point where the impact becomes positive or negative - that is the point of vulnerability - could be either in a house or in the community.

Negative or positive environmental impacts occur at the end of a chain which is summarized as follows:

activities -> residuals -> dispersal -> exposure at points of vulnerability -> impacts

It is important to remember that environmental impacts only become externalities when they are not reflected in the cost of basic market transactions.

2.3 Impacts Associated with Meeting Energy Service Requirements in the Yukon

In order to meet their future energy needs, Yukon people can choose between various forms of energy, each of which will have environmental externalities. Therefore, identifying impacts is a top priority. The matrix provided at the end of this paper outlines a framework Yukon people can use to identify and discuss energy-related environmental impacts. This structure is a starting point that shows the challenges associated with the issue of externalities.

The matrix identifies potential environmental impacts associated with both the types of energy we use in the Yukon today and the types of energy we may use in the future. Coal for electricity is included to provide a point of comparison, as there is general agreement that coal is one of the most environmentally damaging sources of energy, particularly in terms of greenhouse gas production. Energy efficiency is included in the matrix because, despite its many economic and environmental benefits, it too can result in negative impacts. For example, advanced levels of air tightening in a house can contribute to severe health problems unless accompanied by appropriate ventilation.

3. GENERAL APPROACHES TO ADDRESSING ENVIRONMENTAL EXTERNALITIES

3.1 How Are Environmental Externalities Currently Addressed?

At present, environmental externalities are treated in a number of ways. They can be ignored or cleaned-up; compensation can be provided after damages have been done, they can be regulated against or mitigated through project planning.

Up until now, when externalities have been dealt with, it has usually been through government involvement. What is important to recognize, however, is that government involvement has not removed the costs to society of these impacts. Depending on the role played by government, the responsibility for costs has shifted between the taxpayers at large, the producers, or the consumers of energy.

- Ignore

  In some cases, externalities have been overlooked through ignorance rather than deliberate neglect. However, even when understanding and scientific evidence has accumulated, action has often been postponed until public pressure or legal threats force action. For example, the first signs of environmental damage from sulphur emissions - in the form of declining fish populations and dying lakes - occurred in Scandinavia in the 1960s.

Efforts to reduce these emissions came much later, and in many jurisdictions, there are still few efforts being made in this direction. Despite the introduction of formal project review processes (in particular, Environmental Impact Assessment (EIA)), and more stringent regulatory controls, there are many impacts associated with energy production and consumption that continue to be effectively ignored, particularly those that are incremental in nature. For example, little consideration may be given to the impact on a local waterfowl population of noise and other disturbances associated with oil production facilities. The additional stress of future activities in the region might, however, have serious consequences for the regional waterfowl population.

- Clean-up

The legacy created by ignoring impacts has resulted in costly clean-ups or compensation after the fact. For example, if a mine site has been left in a condition where tailings have been poorly contained, it will require a costly reclamation. In many cases, after-the-fact clean-up has been paid for by the taxpayer rather than by the producer. In these cases, the impacts have remained outside of market processes, so they continue to be externalities.

- Regulate

There are some environmental impacts which have been "internalized" (that is, made part of the costs of doing business) in energy production. These are primarily the costs to the producer of complying with environmental regulations. Regulations may take a variety of forms, the most common of which directly controls what is being emitted into the air or water – so-called end-of-pipe regulations. Usually, the cost of complying with regulations will be passed on to the consumer. For example, a utility that burns coal to generate electricity may install scrubbers to reduce sulphur dioxide emissions. The cost of these scrubbers then becomes part of the cost of producing electricity.

Regulations do not completely remove energy-related externalities. They usually call for reduction, not elimination, of residuals. So if we return to the case of the coal-fired electricity plant, it is important to recognize that sulphur dioxide emissions are not completely removed. At some point these residuals will result in externalities.

- Place Conditions on Project Approval

Conditions may also be established as part of project approval. For example, a government may, as a condition of project approval, require an oil producer to erect sound barriers to mitigate disturbance of a waterfowl population. Again, this becomes a cost of production, so imposed conditions are another way of "internalizing" externalities. These costs are typically passed on to consumers.

3.2 The Whys and Hows of a More Comprehensive Approach

As indicated above, there are some areas where government has forced producers to include the cost of environmental impacts as part of their costs of production. When this happens, consumers receive a price signal which, to some extent, reflects the social cost of meeting their energy service needs. When consumers receive these kinds of price signals, purchase decisions tend to reflect environmental impacts.

Evidence suggests that when energy prices increase, consumers change their energy use patterns, either through the use of energy efficiency measures or through fuel substitution. For example, in the Yukon, wood has displaced part of oil's share in the residential space heating market. What is debatable is the degree to which these changes in energy use patterns occur. There are still market barriers which prevent larger scale adoption of energy efficiency. Clearly, society can move further in the direction of bearing the costs related to environmental impacts.

Even though regulations and mitigation may force partial internalization of the costs of environmental externalities, they seldom reduce to zero the quantity of residuals emitted, or the damages sustained. Thus, between the wide range of uncontrolled impacts and those that endure even after existing controls are enforced, externalities remain, and their existence bears little if any influence on individual or collective decisions about which kinds of energy to develop and use. Moreover, where methods such as compensation are used, the value of compensation generally falls far short of true social costs. So, in fact, when consumers think they're getting a least cost energy option, they are not really taking all factors into consideration.

If one accepts that society must be presented with the true social costs of energy alternatives, the next challenge is to integrate this goal into decision-making related to energy development. The key is to identify and describe environmental impacts.

In other words, because different sources of energy are associated with different externalities, one of the factors that should bear on the development of an energy strategy is the type and degree of external impact associated with each source.

Once all the impacts are identified, the next step would be to establish their worth from society's perspective. This may mean either a qualitative or quantitative assessment of these impacts.

The purpose of the remainder of this issue paper is to explore a more complete integration of environmental externalities in planning and decision-making processes.

4. INCLUDING EXTERNALITIES IN PLANNING AND DECISION-MAKING

4.1 Background: Steps in the Development of an Energy Strategy

The development of a Yukon Sustainable Energy Strategy will require a planning and decision-making process that includes the following elements:

- agreement on future energy service needs (kinds and levels)
- determination of options available to satisfy those needs
- analysis of the costs of each option
- selection of least cost options

It is in the analysis of costs that we are faced with the challenge of bringing externalities into the process. In general, the introduction of externalities into the costing of energy options requires the following steps:

- identification of externalities (i.e., those impacts which have not been internalized as costs)
- characterization and quantification of impacts
- valuation of damages

4.2 Identifying, Characterizing, and Quantifying Externalities

As mentioned before, the first step in any approach to full integration of environmental externalities into decision-making is to identify the range of residuals and/or impacts associated with the full life cycle of each energy option. This may begin with a "check-list", based on the format presented in Figure 1. In some cases residuals, such as emissions associated with acidification, may be easier to quantify than more general impacts.

Once negative or positive environmental impacts have been identified, the next step would be to characterize these impacts in terms of their severity. At this stage in the process planners must, of necessity, begin to quantify the impacts. Some impacts may be easier to quantify than others. For example, wood and fossil fuel particulate emissions can be measured in parts per million. However, measuring climate change using sophisticated computer models is still controversial.

A relatively high level of certainty and explicitness about damages is important for decision-making. Quantitative characterization is therefore desirable, but the constraints on accurate and objective quantification of many environmental damages are enormous.

To date, most attention, related to the environmental externalities of energy, has focused on air emissions. One approach to quantifying emissions damage, termed "relative potency," involves estimating the relative intensity and significance of the effects of various pollutants. This approach works well when comparing emissions against a given effect, for example, global warming. The global warming potency of each of the key greenhouse gases (carbon dioxide, methane, nitrous oxide, carbon monoxide and CFCs) can be compared, using carbon dioxide as the base. Similarly, gases causing acid rain can be compared.

The polling of a representative group of experts, if carefully conducted, may be one of the best means of clarifying relationships between residuals, such as sulphur dioxide emissions, and damages, such as a decline in fish populations. However, in many cases, basic understanding and expert consensus are lacking. It should also be remembered that, given regional differences in biophysical, demographic, and economic characteristics, the relative damage caused by a given residual will vary greatly. Thus, it is often neither feasible nor appropriate to assume the same types and levels of damage, or the same value of damages, in different regions.

What we can conclude from efforts to quantify energy-related environmental impacts is that human judgment and values play an important role in this process. On the one hand, we may desire a truly least social cost approach be used. On the other hand, we may have to accept that human values will influence choices made in the planning process that may lead to a less than least cost set of options.

4.3 Valuing Damages: To Assign Monetary Value or Not?

Once energy-related environmental impacts have been quantified, the next challenge in the planning process is to establish a monetary or dollar value for these impacts. While there is no doubt that this is an important part of achieving the goal of least social cost planning, the planning process cannot rely entirely on monetary values.

It can be argued that if decision-making processes were better structured to deal with non-monetary considerations, it would not be necessary to assign monetary values to all damages in order to address externalities in planning and development decisions. In fact, Yukon people have often stated the importance of recognizing non-monetary values in decision-making, and have expressed the desire to participate in decision-making about the management of resources.

Indeed, there are many kinds of damages that can not, or should not, be priced. These might include impacts which cannot be accurately measured, damages whose quantification and monetary valuation would be too subjective (e.g., impacts on ecological processes such as energy and nutrient cycling), and issues that are ethically complex or politically sensitive (e.g., wholescale relocation of native communities). Rather than ignoring impacts that are difficult to quantify, qualitative methods must be explored to include them in the decision-making process. This is not an unrealistic goal. For example, one of the largest utilities in the eastern U.S., the New England Electric System (NEES), has developed a method for a qualitative scoring of environmental externalities.

Perhaps the best option is not to choose between a qualitative or quantitative approach, but rather to work towards a planning process that uses the best features of both approaches. The two approaches are further explored below.

4.4 The Monetary Approach: Full Costing

A quantitative approach to externalities valuation is based on the assignment of a monetary - or dollar - value to an environmental residual, such as sulphur dioxide emission, or an environmental impact, such as freshwater lake acidification (caused, in part, from sulphur dioxide emissions). A full cost approach would attempt to assign dollar costs to residuals or impacts at each stage in the energy development and supply cycle. For the most part, we still have a long way to go before full cost valuation becomes standard practice. The current monetary approaches are summarized below:

- **Damage Cost Approach**

With this approach, externalities are assigned a value in relation to the damage they are expected to cause. Value is, therefore, determined by both the risk and magnitude of damage. The values are determined, in part, on the basis of similar projects in other jurisdictions. For example, a damage cost approach for a hydro site might examine how similar projects flooded land and disrupted both ecosystems and communities. Values would be based on indicators such as costs of compensation.

In other cases, the damage values could be based on the costs of cleanup. Where a market price already exists, for a commercial fishery, for example, this can serve as a measure of the externalities value.

The damage cost approach is limited because of the difficulty in comparing the experience of one situation to another. Damage can either be overestimated or underestimated. Moreover, the damage valuation usually does not address the full cycle of energy development and supply. Finally, how do you value the long-term effects? No one knows, for example, the eventual cost of climate change.

- **Control Cost Approach**

With this approach, externalities are assigned a monetary value based on the costs of controlling residuals or impacts. Perhaps the most studied control costs have been in the area of fossil fuel emissions. Numerous studies have attempted to establish the costs of reducing emissions such as sulphur dioxide, nitrous oxides, particulates and carbon dioxide. Monetary values are based on how much control technology costs. For carbon dioxide, analysts have used the cost of planting trees, known as a carbon "sink," as a measure of control cost.

The control cost approach is limited because it does not represent the costs of the full cycle of energy development and supply. In addition, costs may be based on measures which fall short of substantial reductions or even elimination of residuals.

- **Contingency Evaluation For The Willingness-to-Pay Approach**

This approach is based on surveying the public to determine their "willingness-to-pay" for prevention or reduction of residuals. For example, the public might be asked whether it is willing, and how much it is willing, to pay to preserve an old growth forest.

The major problem with this approach is that survey responses can be highly misleading. For one thing, the way in which questions are asked can bias response. Perhaps more importantly, the public may overestimate its willingness to pay because it feels it is very unlikely they will ever have to actually do so. Conversely, they may understate their willingness to pay, for fear that they may be a target for payment.

4.5 Non-Monetary Approaches: Qualitative Valuation

Whether or not efforts are made to continue with a monetary approach to setting value on externalities, there is an important role for the development of a non-monetary approach. Under this approach, human judgment and subjectivity are extremely important. This approach also creates an opportunity to involve all stakeholders in a decision-making process, with the goal of achieving collaboration and consensus.

A qualitative approach is often based on the ranking of alternatives. To establish a ranking, decision-makers and stakeholders identify all of the relevant environmental residuals and impacts. Based on these impacts, they then try to establish qualitative criteria to be used to rank the energy alternatives. These criteria include, for example, risk of damage, scope of damage, and probability/timing of damage. The criteria are typically weighted to reflect value priorities and then "scored" to achieve a ranking.

4.6 Valuation Trends

Trends in North America today suggest that assigning value to externalities is here to stay. Both monetary and non-monetary approaches are being used to internalize externalities in an effort to develop least cost planning based on social costs. What is uncertain is whether determining the value of externalities is actually leading to different price signals in the market. It is also uncertain whether least cost planning based on externalities valuation will address all forms of energy.

The area where there has been the greatest progress in assigning value to externalities is with electric power planning in the U.S. Here, the focus has been on assigning a monetary value to externalities and, not surprisingly, much effort has been focused on the costs of fossil fuel emission control. Regulators at the state level have been the driving force behind undertaking studies and in making sure that externalities valuation becomes an integral part of least cost planning.

Today, over 30 states in the U.S. require, or are actively considering, requirements for utilities that will include the costs of externalities in planning, bidding, or other electric power resource options. As the study of externalities valuation continues to evolve, regulators have recognized that full costing will not be achieved nor accepted overnight. What many regulators have done is to use both monetary and non-monetary methods to arrive at "benchmark" values; these values serve either as penalties or credits to the costing of various energy alternatives. For example, the Northwest Power Planning Council grants a 10 per cent credit to energy efficiency initiatives. The Wisconsin Public Utilities Commission gives non-combustion resources, such as energy efficiency and hydro, a 15 per cent credit when compared to combustion-based resources.

One issue that hasn't yet been fully addressed is the potential inability for externalities valuation to affect current, as opposed to future, least cost energy alternatives. As it currently stands, the emphasis of externalities valuation has been to identify least cost options for future energy resource options. In theory, this is supposed to force the utilities to make least cost choices to meet their systems requirements. However, this appears to have little effect on the current prices paid by electricity customers. This means, of course, that customers are not getting all of the market signals required to make least cost purchase decisions.

5. CONCLUSION

This paper has attempted to define externalities and describe the type of environmental externalities that could be generated from energy resource development in the Yukon. Approaches to externalities valuation have also been described. How should externalities fit into the Yukon energy strategy development process?

The first thing to realize is that this issue is an extremely complex one that offers no simple solutions such as simply choosing one program or another program. Rather, the issue of externalities is best addressed as part of the overall strategy or framework for putting the **idea** of a sustainable Yukon energy future into **action**.

By including externalities in the planning process, Yukon people have to address questions fundamental to implementing a sustainable energy future. For example, what are all of the impacts (cultural and social in addition to environmental) associated with all of the energy resource options? How should these impacts be valued? How should impacts be weighed? Who should be involved in the process? What should the regulator's role be? How can a process be established that doesn't paralyse government and the private sector? How should externalities valuation affect current energy prices?

In the end, assigning value to externalities should help Yukon people make energy choices on the basis of least cost to society. However, even if we address all of the questions related to externalities, we will still not have considered all of the issues fundamental to a sustainable energy approach. One major issue to address is equity. Who will pay the costs of impact control or elimination? How will these costs be shared?

As these questions are pondered, it is also useful to recognize that, in the end, decisions will be made on the basis of imperfect information. These decisions will also be based on the very important influencing force of human values.

FIGURE 1: MATRIX FOR IDENTIFICATION OF ENERGY-RELATED ENVIRONMENTAL IMPACTS IN THE YUKON

[illegible]			Coal		Wood (for heating)		HFOs			Natural Gas		Hydro-Electricity (all sizes)		Solar		Wind		Geo-Thermal	[illegible]
			for heating	for electricity (assuming low S coal or scrubbers	for heating	for electricity	for heating	for transportation	for electricity	for heating	for transportation	micro hydro	large dams	small scale (home use)	large scale (electricity)	small scale	large scale		
PHYSICAL IMPACTS	loss of land (pre-empiem of other uses)																		
	ecosystem/habitat disruption - land																		
	ecosystem/habitat disruption - water																		
	sediment disruption																		
	noise																		
EMISSIONS	Greenhouse Gases	carbon dioxide CO_2																	
		Methane CH_4																	
		nitrous oxide N_2O																	
	Acidifying Gases	sulfur dioxide SO_2																	
		oxides of nitrogen NO_x																	
	Other Air Pollutants	Particulates																	
		hydrocarbons																	
		ground level ozone																	
		CO																	
	Human Health Impacts (incl. indoor air quality)																		
	Soil and Water Pollutants	heavy metals																	
		other (eg acid rain oil)																	
	Solid Wastes																		
RISKS/ IMPACTS ASSOCIATED WITH MAJOR ACCIDENTS																			